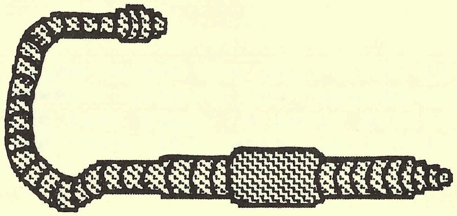
APPLE

COMPUTER
BIOLOGY
LAB

EARTHWORM



CROSS EDUCATIONAL SOFTWARE

WORM DISSECTION

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Larry Newby

Sold by
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INTRODUCTION

"WORM DISSECTION" should be used as a pre-lab or post-lab computer activity. It gives instructions and definitions that a student should know before entering the lab. After a dissection, the program can be used as a self-test.

GETTING STARTED

All you have to do is put the disk in an Apple computer and turn on the power. After a few seconds the screen will show the menu on the next page. A color monitor will help, but the pictures are compatible with black and white.

COPIES

This disk is protected against being copied. A backup disk is included in case of accident. If the disk doesn't run when you receive it, it will be replaced free. Just mail it back to Cross Educational Software. If the disk fails after being used for 30 days, it could be due to mishandling, such as a scratch or a fingerprint. After 30 days there is a $6 charge to replace a disk.

THIS MANUAL

The following pages are a summary of the program. The test pages may be duplicated and given to the students.

MAIN MENU:

1. ORIENTATION
2. STRUCTURES AND FUNCTIONS
3. DISSECTION
4. SELF - TEST

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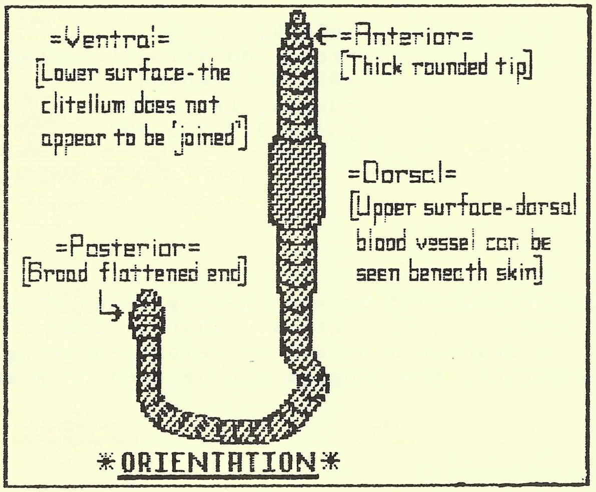
1. ORIENTATION

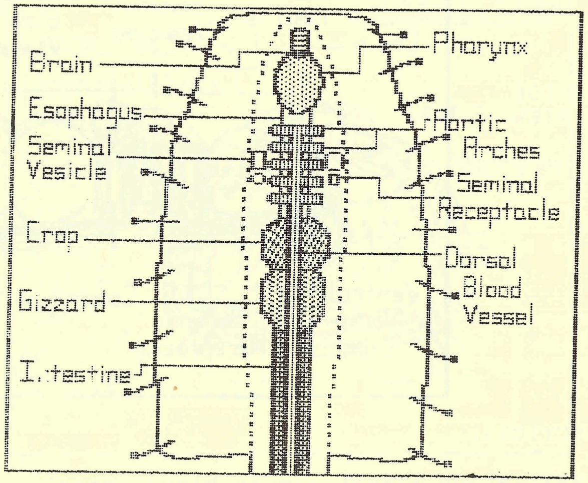

=Ventral=
[Lower surface-the clitellum does not appear to be 'joined']
=Anterior=
[Thick rounded tip]
=Dorsal=
[Upper surface-dorsal blood vessel can be seen beneath skin]
=Posterior=
[Broad flattened end]
ORIENTATION

VOCABULARY LIST:

ANTERIOR
ANUS
AORTIC ARCHES
BRAIN
CIRCULAR MUSCLE
CLITELLUM
CROP
CUTICLE
DORSAL
DORSAL BLOOD VESSEL
EPIDERMIS
ESOPHAGUS
GANGLIA
GIZZARD
INTESTINE
LONGITUDINAL MUSCLE
MOUTH
NEPHRIDIUM
PHARYNX
POSTERIOR
PROSTOMIUM
SEGMENTS
SEMINAL RECEPTACLES
SEMINAL VESICLES
SETAE
VENTRAL
VENTRAL BLOOD VESSEL
VENTRAL NERVE CORD

STRUCTURES AND FUNCTIONS

1) DORSAL VIEW



BRAIN - tiny nerve center forming a collar around the pharynx.

AORTIC ARCHES - 5 pairs of muscular tubes that act as hearts. They connect the dorsal and ventral blood vessels.

SEMINAL VESICLES - male reproductive part. Stores sperm cells to be sent to another worm.

SEMINAL RECEPTACLES - female reproductive part. Stores sperm cells received from another worm.

ESOPHAGUS - connects pharynx to crop.

DORSAL BLOOD VESSEL - main blood vessel. Carries blood toward the anterior.

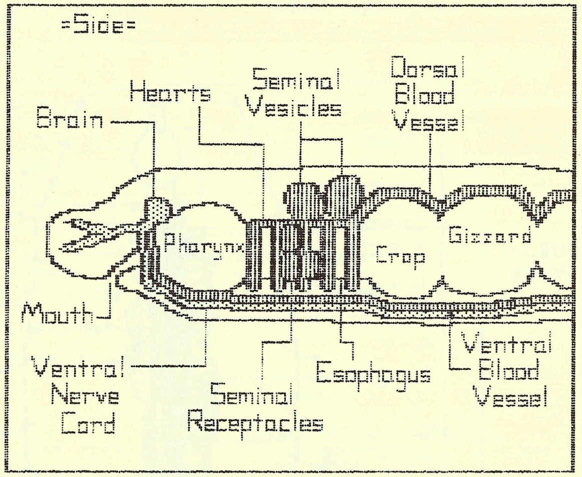
CROP - storage area for food.

GIZZARD - muscular organ. Grinds food.

INTESTINE - largest organ. Digests food.

PHARYNX - muscular organ that forces food into the esophagus.

2) SIDE
VIEW



FUNCTIONS:

DORSAL BLOOD VESSEL - main blood vessel. Carries blood toward the anterior.

VENTRAL NERVE CORD - main nerve in a worm's body.

BRAIN - tiny nerve center forming a collar around the pharynx.

AORTIC ARCHES - five pairs of muscular tubes that act as hearts They connect the dorsal and ventral blood vessels.

SEMINAL VESICLES - male reproductive part. Stores sperm cells to be sent out.

SEMINAL RECEPTACLES - female reproductive part. Stores sperms cells from another worm.

ESOPHAGUS - connects pharynx to crop.

MOUTH - semicircular slit at anterior.

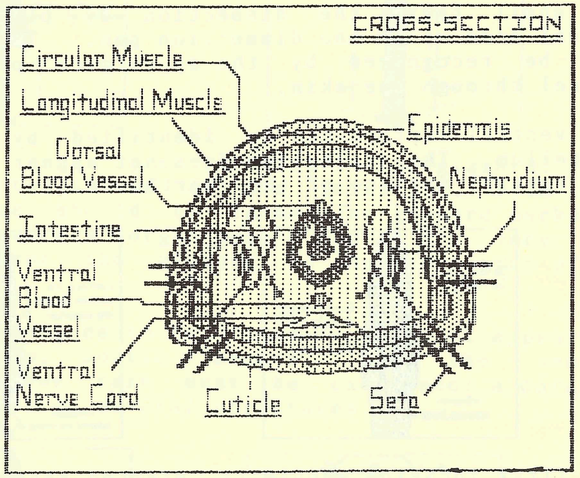
PHARYNX - muscular organ that forces food into the esophagus.

CROP - storage area for food.

GIZZARD - muscular organ. Grinds food.

VENTRAL BLOOD VESSEL - main blood vessel. Carries blood to the posterior.

3) CROSS
SECTION



FUNCTIONS:

CIRCULAR MUSCLE - wrapped around body. Causes body to become longer and thinner.

LONGITUDINAL MUSCLE - runs the length of the body. Causes the body to shorten.

DORSAL BLOOD VESSEL - main blood vessel. Carries blood toward the posterior.

INTESTINE - largest organ. Digests food.

VENTRAL BLOOD VESSEL - main blood vessel. Carries blood toward the posterior.

VENTRAL NERVE CORD - main nerve in worm's body.

CUTICLE - protective outer layer.

SETA - (plural/setae) bristles used for movement.

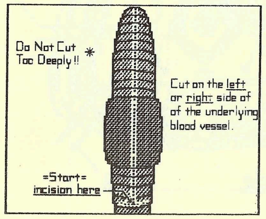
NEPHRIDIUM - (plural/nephridia) tiny kidneys of a worm that filter the blood.

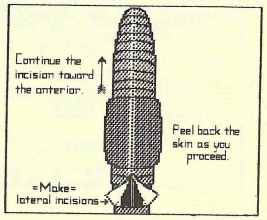
EPIDERMIS - outer layer of skin.

DISSECTION

We shall begin the dissection by placing the specimen dorsal side up on the dissection pan. The dorsal surface can be recognized by the appearance of the dorsal blood vessel through the skin.

The ventral surface can be identified by looking at the clitellum. The clitellum does not appear to be 'joined' on the ventral surface of the earthworm.


Do Not Cut Too Deeply!! *
Cut on the left or right side of of the underlying blood vessel.
=Start= incision here


Continue the incision toward the anterior.
Peel back the skin as you proceed.
=Make= lateral incisions

The first incision should be started about one to one and a half inches behind or posterior to the clitellum on the dorsal surface. This incision should be to one side or the other of the dorsal blood vessel. It makes no difference if it's the right or left side.

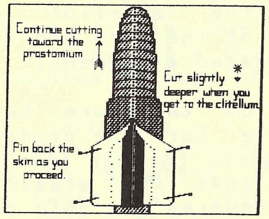
Use the scalpel to start the incision and continue the cut with either a pair of scissors or your scalpel. You will be cutting toward the anterior of the worm. Continue the incision toward the anterior end of the worm using the dorsal blood vessel as a cutting guide.

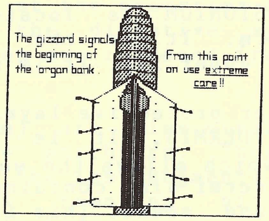
Be very careful to not cut too deeply!
The worm is very thin skinned so cut with care.

After your incision reaches the clitellum, return to the point at which you started. There, make two lateral incisions as illustrated in the picture. Pull back the skin very carefully. You should be able to see the first major organ, the intestine, and the blood vessel on top of it.

As you continue the incision toward the anterior end you must cut through the clitellum. Because of the thickness of the clitellum you must cut slightly deeper. Again, be careful! If the incision is too deep you will damage underlying organs.

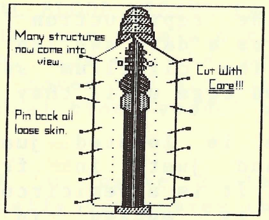
Pin back the skin as you proceed. (See picture.)
Your internal view will not change very much until you get to the anterior end of the clitellum.

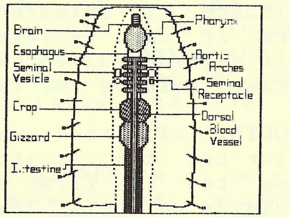

Continue cutting toward the prostomium
Cut slightly deeper when you get to the clitellum. *
Pin back the skin as you proceed.


The gizzard signals the beginning of the 'organ bank'.
From this point on use extreme care!!

The next major organ you see will be the gizzard. It is located at the anterior end of the intestine. From this point extra care should be taken! The gizzard marks the beginning of the worm's 'organ bank'. There are very many organs packed from the gizzard to the prostomium of the worm.

The next major organs to be viewed in order of appearance will be: the crop, aortic arches, and the seminal receptacles. Extreme care must be exercised! a careless incision could destroy several structures.





Continue the incision until you get to the very tip or prostomium.

At this point all loose skin flaps should be pinned down. Most structures can now be viewed. (See picture.)

Drops of water should be sprinkled over the internal organs occasionally to stop them from drying out.

In the following section we shall discuss some of the major organs found in the earthworm and what their functions are in the worm's body.

The PROSTOMIUM is located at the anterior of the earthworm. It is the very tip of the worm and acts as a type of upper lip. It is not considered a segment.

The outer protective layer of skin on the worm is called the EPIDERMIS. It is responsible for the production of mucus which allows the worm to breathe through its skin.
The epidermi also contains cells that are sensitive to light and sound. This is how earthworms are able to escape from their enemies even though they have no eyes or ears.
The CUTICLE is a thin layer that is secreted by the epidermis. It is kept moist by the mucus which is also secreted by the epidermis. This mucus is necessary for effective oxygen transfer to take place through the skin.

The tiny hair-like bristles that are found on the ventral surface and on the sides of the earthworm are called SETAE. (singular-seta). There are four pairs of these bristles found on each segment of the worm except the first and last segments. They aid the worm in moving by pushing themselves into the soil and holding on.

The CLITELLUM is involved in the reproduction of the earthworm. It can be identified as a dark swelled area that occurs in segments 32 through 37. The clitellum serves as an egg case, holding the fertilized eggs until they hatch.

The MOUTH of the earthworm is located just behind (posterior to) the prostomium and just in front of (anterior to) the first segment. It is a semicircular slit that contains no teeth. The food is 'sucked' in through the mouth.

Just posterior to the mouth is the PHARYNX. The pharynx is a very muscular organ which sucks in the food or the soil (which contains food) and forces it back into the esophagus. The ESOPHAGUS is a round tube-like structure which connects the pharynx to the crop. The CROP is a round shaped organ found just posterior to the esophagus. It is used as a storage area for the food before it is forced back into the gizzard.

After the food leaves the crop, it enters the GIZZARD. The gizzard is very muscular and is located between the crop and intestine. It contains grains of sand which, while the gizzard is contracting, grind and pulverize the food particles so they can be more easily digested.

Finally the food enters the INTESTINE. The intestine is the largest organ of the digestive system. It extends from the nineteenth segment to the end of the body.
Final digestion takes place here. Digestive enzymes chemically break down the food particles and the blood absorbs the digested food through the intestinal wall.

The ANUS is a vertical slit found at the posterior end of the earthworm. It is the end of the digestive system. Feces or undigestible food particles are released from the digestive system through the anus.

NEPHRIDIA (singular - nephridium) are tiny structures located in most all segments of the earthworm. They are not found in segments 1, 2, 3, or the last segment. These structures serve as tiny kidneys removing nitrogen-containing wastes from the earthworm's body.

There are five pairs of AORTIC ARCHES found in the earthworm. They are not true hearts but actually muscular tubes that connect the dorsal blood vessel to the ventral blood vessel. By contracting and relaxing they help keep the blood moving in the worm's body.
The DORSAL BLOOD VESSEL is a major part of the earthworm's circulatory system. It carries blood toward the anterior end of the worm and is connected to the ventral blood vessal by means of the aortic arches and small connecting tubes. It is located on the dorsal surface of the digestive system.
The VENTRAL BLOOD VESSEL is also one of the main blood vessels in the worm's circulatory system. It is located on the ventral side of the intestine just above the nerve cord. It moves the blood to the posterior and is connected to the dorsal blood vessel by small tubes and the aortic arches.

The BRAIN or nerve center of the earthworm is very tiny. It is actually two nerves that form a collar around the anterior portion of the pharynx. These nerves join just below the pharynx to form the ventral nerve cord which runs the length of the worm's body.
The VENTRAL NERVE CORD is the main nerve cord in the earthworm's body. It runs along the ventral portion of the body just below the digestive system. Enlargements in the nerve cord are called GANGLIA. They function as nerve centers. There are six smaller nerves that branch out from each ganglion.

The SEMINAL VESICLES are the 'male' reproductive part of the earthworm. They store sperm cells produced by the testis until the sperm cells are transferred to another worm. The SEMINAL RECEPTACLES are the 'female' reproductive cells of the earthworm. They store the sperm cells from another worm until those sperm cells are used to fertilize eggs.

The LONGITUDINAL MUSCLES run the length of the earthworm's body. By contracting these muscles the worm is able to make its body shorter and thicker. CIRCULAR MUSCLES are found wrapped around the worm's body in each segment. When contracted they cause the worm's body to become long and slender. When the circular and longitudinal muscles are used together with the setae they provide the basis for movement.

MULTIPLE CHOICE TEST ON FUNCTIONS OF THE PARTS

___ 1. The storage area for food is the ...
(a) crop (b) intestine (c) gizzard (d) setae

___ 2. The hair-like bristles the worm uses for movement are ...
(a) found on the dorsal side (c) seminal vesicles
(b) grouped in threes (d) setae

___ 3. The prostomium is ...
(a) found at the posterior end.
(b) found at the anterior end.
(c) found on the dorsal surface.
(d) found on the ventral surface.

___ 4. The seminal vesicles are ...
(a) the male reproductive organs.
(b) the female reproductive organs.
(c) part of the digestive system.
(d) part of the nrevous system.

___ 5. The egg case of the worm is called the ...
(a) pharynx (c) clitellum
(b) prostomium (d) esophagus

___ 6. Which organ is the largest in the digestive system?
(a) esophagus (c) crop
(b) gizzard (d) intestine

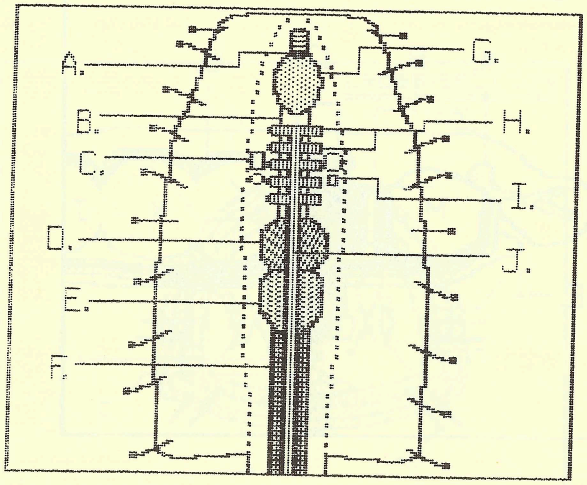
___ 7. The gizzard is responsible for ...
(a) grinding the food. (c) digesting the food.
(b) storing the eggs. (d) pumping the blood.

___ 8. The aortic arches cover which organ?
(a) brain (b) gizzard (c) intestine (d) esophagus

___ 9. The muscular organ that forces food into the esophagus is called the
(a) crop (b) gizzard (c) pharynx (d) prostomium

___10. The aortic arches are part of the...
(a) digestive system
(b) circulatory system
(c) nervous system
(d) reproductive system

PARTS MATCHING TEST - DORSAL VIEW



___ 1. SEMINAL RECEPTACLE

___ 2. CROP

___ 3. PHARYNX

___ 4. AORTIC ARCHES

___ 5. BRAIN

___ 6. INTESTINE

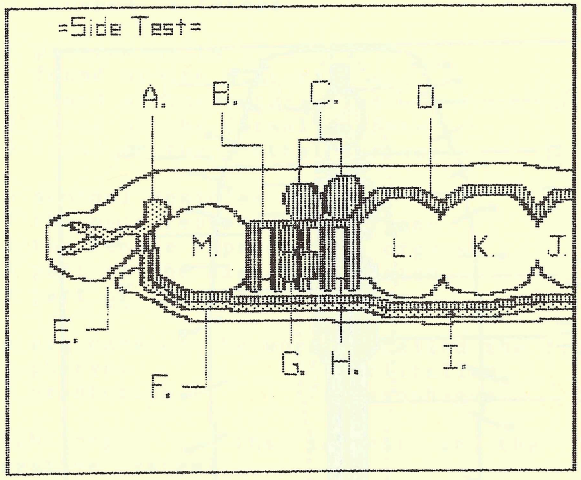
___ 7. DORSAL BLOOD VESSEL

___ 8. SEMINAL VESICLES

___ 9. GIZZARD

___ 10. ESOPHAGUS

PARTS MATCHING TEST - SIDE VIEW



__ 1. CROP

__ 2. BRAIN

__ 3. SEMINAL RECEPTACLE

__ 4. SEMINAL VESICLE

__ 5. PHARYNX

__ 6. GIZZARD

__ 7. VENTRAL NERVE CORD

__ 8. MOUTH

__ 9. INTESTINE

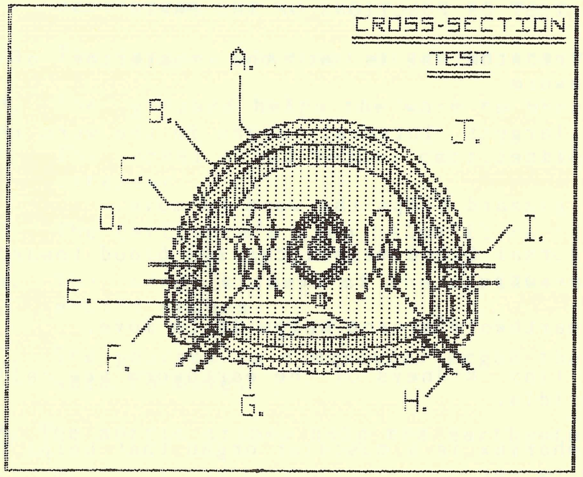
__10. DORSAL BLOOD VESSEL

__11. ESOPHAGUS

__12. VENTRAL BLOOD VESSEL

__13. HEARTS

PARTS MATCHING TEST - CROSS SECTION VIEW



__ 1. INTESTINE

__ 2. EPIDERMIS

__ 3. CIRCULAR MUSCLE

__ 4. VENTRAL NERVE CORD

__ 5. DORSAL BLOOD VESSEL

__ 6. NEPHRIDIUM

__ 7. LONGITUDINAL MUSCLE

__ 8. SETA

__ 9. CUTICLE

__10. VENTRAL BLOOD VESSEL

TRUE / FALSE TEST ON FUNCTIONS OF THE PARTS

___ 1. The prostomium is at the posterior of the earthworm.

___ 2. The largest internal organ in the worm is the intestine.

___ 3. The gizzard helps the worm to move.

___ 4. The dorsal blood vessel carries blood toward the posterior.

___ 5. The earthworm's crop helps it to move.

___ 6. The tiny kidneys of the earthworm are called nephridia.

___ 7. The pharynx is a muscular organ that helps the worm to eat.

___ 8. The aortic arches support the worm's body.

___ 9. The seminal vesicles are the female part of the earthworm.

___10. The longitudinal muscles wrap around the earthworm's body.

TRUE / FALSE TEST #2

___ 1. The prostomium is at the anterior of the earthworm.

___ 2. The largest internal organ in the worm is the crop.

___ 3. The gizzard helps the worm to breathe.

___ 4. The dorsal blood vessel carries blood toward the anterior.

___ 5. The earthworm's crop helps it to reproduce.

___ 6. The tiny kidneys of the earthworm are called aortic arches.

___ 7. The pharynx is a muscular organ that helps the worm to move.

___ 8. The aortic arches help the earthworm to reproduce.

___ 9. The seminal vesicles are the male part of the earthworm.

___10. The longitudinal muscles run the length of the earthworm's body.

TRUE / FALSE TEST #3

___ 1. The prostomium is located under the clitellum.

___ 2. The largest internal organ in the worm is the gizzard.

___ 3. The gizzard grinds and crushes food particles.

___ 4. The dorsal blood vessel carries blood to the lungs.

___ 5. The earthworm's crop stores food.

___ 6. The tiny kidneys of the earthworm are called setae.

___ 7. The pharynx is a muscular organ that pumps blood in the worm.

___ 8. The aortic arches act as hearts in the earthworm.

___ 9. The seminal vesicles are part of the digestive system.

___10. The longitudinal muscles cause the worm to become long and thin.